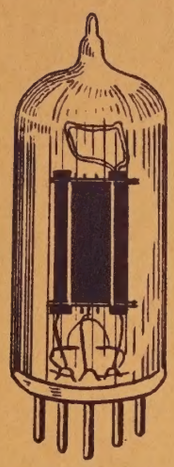
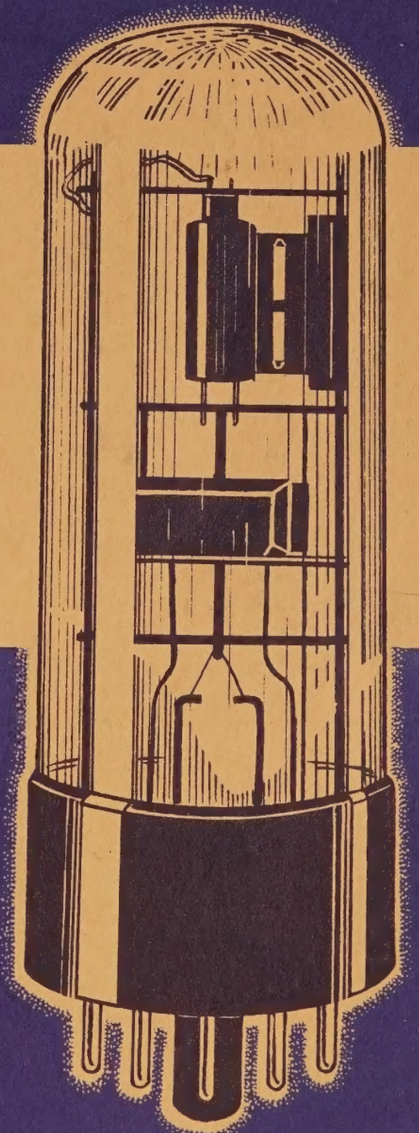
A RIDER PUBLICATION

FEATURING TV PICTURE TUBES

SECOND SUPPLEMENT

RECEIVING TUBE





SUBSTITUTION GUIDE BOOK

BY H. A. MIDDLETON

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SECOND SUPPLEMENT

RECEIVING TUBE SUBSTITUTION GUIDEBOOK

BY

H. A. MIDDLETON

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FOREWORD

This Second Supplement to the Receiving Tube Substitution Guidebook, in addition to the original volume and the First Supplement to it, is an accumulation of over twelve years of experience in substituting tubes in radios, television receivers and other electronic equipment. It is a never-ending process which we shall continue in an effort to keep your information as current as possible.

Most of these additional substitutions are for use in television receivers and therefore, because of their critical application in some cases, special consideration should be given your selection when you have a choice of substitutes. A stage-by-stage discussion of the most popular circuits used in television receivers is included in the First Supplement. If there is any question as to whether or not the stage being substituted is a critical one and which characteristics of the substitute should be given special consideration, take a moment to read the article covering the stage in question.

The information herein, in the large part, calls for substitutions only. It is not the object of these instructions to tell you how to improve radios, television receivers and other electronic equipment but rather to help you use the tubes you have, in order to replace those that are not available. Exceptions to the above statement are tubes especially designed as replacements of types where improvement is needed generally or for specific use such as 5881 for 6L6, 5AW4 for 5U4G, 6CU6 for 6BQ6GT, and the same type numbers in ruggedized tubes designated by an additional ending letter, as 6SN7WGT. Types such as these are designed to improve the life of the tube, the efficiency of the circuit in which they are applied, or both. Characteristics are generally identical to the type they replace. Elements are heavier duty or especially treated in order to withstand greater overloads and construction is more rugged.

Also included in this supplement is a cumulative index indicating the volume and page where the tube you wish to substitute is located.

We have endeavored to list all the practical substitutions. Some, no doubt, have been omitted. When considering substitution, others not listed will likely come to mind. When this happens, write the tube number down immediately in the form used here and attach it in its proper place.

This supplement includes picture tube substitutions. It is recommended that before substitution of picture tube is attempted, a few moments be taken to read over the short article which precedes the picture tube section.

Phoenix, Arizona
January, 1954

H. A. Middleton

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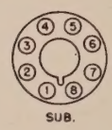
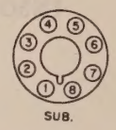
TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
1B3	1AX2	E	Change socket to noval and rewire as follows:
	1X2A	E	No. 2 on octal to No. 2 noval 7 to 8
			ORIG. SUB.
			Pins 3 and 7 may be used as tie points for filament and high voltage filter resistors.
1D5GP	1N5GT	G	Parallel circuits – add 10 ohm 1/2 watt resistor in series with filament circuit. Series circuits — in addition to above resistors, shunt a 200 ohm 1/2 watt resistor across the combination.
	1P5	G	Same as above.
1X2 1X2A	1AX2	E	It may be necessary to increase the filament current by removing the filament resistor or adding a turn to the filament loop.
5AW4	5U4	G	No changes.
	5X4	G	
	5V4	G	
5AZ4	5AW4		
5R4GY	5AW4		
5T4	5AW4		
5U4	5AW4		
5V4	5AW4		
5W4	5AW4		
5X4	5AW4		
5Y3	5AW4		
5Y4	5AW4		
5Z3	5AW4		
5Z4	5AW4		
6AB4	6AQ6	P	Rewire as follows: Remove wires anchored on No. 5 and tape up. Disconnect No. 2 if grounded. No. 7 to No. 2 1 to 7 6 to 1 Connect Nos. 5 and 6 to chassis. ORIG. SUB.
	6AV6	P	Same as above. Parallel circuits only.
	6BF6	P	
	6BK6	P	
	6BT6	P	
	6BU6	P	
6AF4	6AN4	G	No changes.
6AG5	6CF6	G	

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6AH4	6BL7	E	Parallel circuits only. Rewire as follows.
	6BX7	E	No. 8 to No. 3 2 to 8



Connect together Nos. 3 & 6, 2 & 5, 1 & 4.

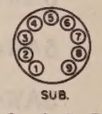
	6F6	G	Parallel circuits only. Rewire as follows:
	6K6	G	No. 5 to No. 3 & 4
	6L6	E	1 to 5
	6U6	E	
	6V6	E	
	6W6	E	



	6SN7	E	Parallel circuits only. Rewire as follows:
			No. 8 to No. 3
			2 to 8

Connect together Nos. 3 & 6, 2 & 5, 1 & 4.

	12AU7 12BH7	E	Parallel circuits only. Change socket to noval and rewire as follows:
			No. 1 to No. 2
			5 to 1
			8 to 3
			2 to 9
			7 to 4



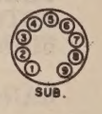
Connect together Nos. 1 & 6, 2 & 7, 3 & 8, 4 & 5.

6AH6	6CH6	G	Parallel circuits only. Change socket to noval and rewire as follows:
			No. 1 to No. 2
			2 to 9
			3 to 4
			4 to 5
			5 to 7
			6 to 8
			7 to 3

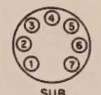
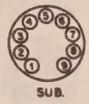
Nos. 1 and 6 are internal connections in the 6CH6 tube. Do not use these for tie points.

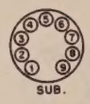
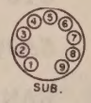
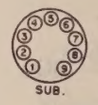
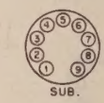
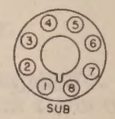
6AJ4	6AM4	G	No changes.
6AJ5	6CF6	P	Parallel circuits only. No changes.
6AJ8	12AH8	G	This will operate if pins 7 & 9 are connected together. Rewire as follows:

Remove wires from No. 9 and put them on No. 7. Remove wires from No. 4 (or 5) and put them on No. 9. Connect No. 4 to No. 5.



6AK5	6CF6	G	

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6AK6	6AM5	G	Parallel circuits only. Rewire as follows: No. 7 to No. 2 6 to 7
			
6AK8	6T8	E	No changes.
6AM4	6AJ4	E	No changes.
	6AN4	G	Change socket to 7 pin and rewire as follows: All connections to Nos. 1, 3, & 4 must go to No. 2. All connections to Nos. 6 & 9 must go to No. 6. Then as follows: No. 2 to No. 5 5 to 1 or/& 7 7 to 3 8 to 4
	6Q4	G	Parallel circuits only. Rewire as follows: No. 3 to No. 1 (Let any other connections to No. 1 stay there). 2 to 3 4 to 2 7 to 4 9 to 7 5 to 9 8 to 5 6 to 8
			
6AM5	6AK6	E	Heater current different, make necessary changes in series circuit. Rewire as follows: Remove wires from No. 6 and tape up. No. 6 to No. 7 Connect Nos. 7 and 2 together.
6AN4	6AF4	G	No changes.
	6T4	G	No changes.
	6AM4	G	Change socket to noval and rewire as follows: Connections to No. 2 may be distributed between Nos. 1, 3, & 4. Connections to No. 6 may be split up between Nos. 6 and 9. Then as follows: No. 4 to No. 8 3 to 7 1 & 7 to 5 5 to 2
6AQ5	6BM5	E	No changes.
6AS5	6BM5	G	Parallel circuits only. Same as 6AS5 to 6AQ5.
6AV6	6BT6	G	No changes.
6BA6	6CG6	G	
6BC5	6CF6	G	
6BJ6	6BA6	E	Parallel circuits only. No changes.
	12BA6	E	Series circuits only. No changes.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6BK5	6BW6	G	Parallel circuits only. Rewire as follows: Remove and tape up any wires connected to No. 2 and No. 9. No. 1 to No. 7 3 & 7 to 1 & 2 6 to 9 Connect Nos. 3 and 9 together. ORIG.  SUB.
	5686	P	Parallel circuits only. Rewire as follows: Remove and tape up any wires on No. 2 and No. 9 No. 3 & 7 to No. 2 1 to 7 6 to 3 8 to 6 Do not use any other pins for tie points. ORIG.  SUB.
6BK7	6BQ7	G	No changes.
	6BZ7	G	No changes.
	5670	G	Parallel circuits only. Rewire as follows: Reverse 1 & 4 2 & 3 5 & 9 ORIG.  SUB.
6BL7	6BX7	E	No changes.
6BM5	6AQ5	E	No changes.
6BQ6	6CU6	E	No changes.
6BQ7	6BK7	G	No changes.
	6BZ7	E	No changes.
	5670	G	Same as 6BK7 to 5670
6BT6	6AV6	E	No changes.
6BW6	6BK5	G	Parallel circuits only. Rewire as follows: Tape up any wires connected to No. 6. No. 1 & 2 to No. 3 or/& 7 3 to 6 7 to 1 9 to 6 ORIG.  SUB.
6BX6	6BY7	E	No changes.
6BX7	6BL7	E	No changes.
6BY5	5V4	G	This may be used if the two cathodes of the 6BY5 are connected together, and are also connected to the heater. Connect No. 1 and No. 2 together. No. 8 to No. 1 & 2 5 to 6 ORIG.  SUB. Connect a 10 watt 1/2 ohm resistor in series with one side of heater.
	6AX6	E	Parallel circuits only. Rewire as follows: No. 4 to No. 3 1 to 4 ORIG. SUB.
	6AX4	G	In damper service where both sections are paralleled.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6BY5	6U4	P	Rewire as follows:
	6W4	G	No. 1 & 8 to No. 3 4 to 5 2 to 8
			ORIG. SUB.
6BY7	6BH5	G	Rewire socket as follows: Remove any wires from pin No. 6 and tape up. In series circuit shunt 68 ohm 1 watt resistor across 4 & 5. No. 1 to No. 3 7 to 6 8 to 1 9 to 3 Note — pins 7 and 8 are internal connections on the 6BH5 and must not be used for tie points. No. 9 may be used for a tie point.
			ORIG. SUB.
	6BX6	E	No changes.
6BZ7	6BK7	G	No changes.
	6BQ7	E	No changes.
	5670	G	Same as 6BK7 to 5670
6C4	6AQ6	P	Rewire as follows: Remove and tape up wires connected to No. 2. No. 7 to No. 2 1 & 5 to 7 6 to 1 Connect Nos. 5 and 6 to chassis.
			ORIG. SUB
	6AV6	P	Same as above. Parallel circuits only.
	6BF6	P	
	6BK6	P	
	6BT6	P	
	6BU6	P	
6C5	12AT7		Same as 6C5 to 12AU7. In addition, connect together Nos. 1 and 6, 2 and 7, 3 and 8.
			ORIG. SUB.
	12AU7	E	Change socket to noval and rewire as follows: Remove and tape up any wires connected to Nos. 1, 4 and 6. No. 2 to No. 4 & 5 3 to 1 5 to 2 7 to 9 8 to 3
			ORIG. SUB.
	12AV7	G	Same as 6C5 to 12AU7. Parallel circuits only.
	12AX7	P	Same as 6C5 to 12AU7.
	12AZ7	G	Same as 6C5 to 12AU7. Parallel circuits only.
	12BH7	G	Same as 6C5 to 12AU7. Parallel circuits only.
6CB6	6CF6	E	No changes.
6CG6	6AG5	G	Remove and tape up wires on No. 2.
	6AH6	G	Parallel circuits only. No changes.
	6AJ5	G	Same as 6CG6 to 6AG5.
	6AK5	G	Same as 6CG6 to 6AG5.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6CG6	6AM6	G	Rewire as follows: Remove wires from No.2. No. 7 to No. 2 6 to 7 Wires removed from No. 2 connect to No. 6.
	6AU6	G	No changes.
	6BA6	G	No changes.
	6BC5	G	Same as 6CG6 to 6AG5.
	6BD6	E	No changes.
	6BH6	G	Parallel circuits only. Reverse Nos. 2 and 7.
	6BJ6	G	Parallel circuits only. Reverse Nos. 2 and 7.
	6CF6	G	
6CF6	6AG5	G	No changes.
	6AJ5	P	Parallel circuits only. No changes.
	6AK5	G	No changes.
	6AK6	G	Parallel circuits only. Change connections as follows: Reverse connections between terminals 2 and 7.
	6AU6	G	Change connections as follows: Reverse connections between terminals 2 and 7.
	6BA6	G	Same as 6CF6 to 6AU6.
	6BC5	G	No changes.
	6BD6	G	Same as 6CF6 to 6AU6.
	6CB6	E	Direct substitute.
	6CG6	G	Same as 6CF6 to 6AU6.
	5590	G	No changes.
	5591	G	
	5654	G	
	9001	P	
	9003	P	
6CH6	6AH6	P	Parallel circuits only. Change socket to 7 pin and rewire as follows: No. 2 to No. 1 3 to 7 4 to 3 5 to 4 7 to 5 8 to 6 9 to 2
6CK6	6CL6	G	Rewire as follows: Reverse Nos. 1 and 3 Reverse Nos. 6 and 7 Remove and tape up wires on Nos. 8 and 9.
6CL6	6AQ5	G	Change socket to 7 pin and rewire as follows: No. 2 & 9 to No. 1 & 7 1 & 7 to 2 4 to 3 5 to 4 6 to 5 3 & 8 to 6 In series circuits, shunt 20 ohm 2 watt resistor across Nos. 3 and 4.
	6BK5	G	Parallel circuits only. Rewire as follows: Reverse No. 1 and No. 6. No. 7 to No. 6 3 to 8 9 to 7 2 to 3

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6CL6	6BV7	G	Parallel circuits only. Rewire as follows: No. 8 to No. 3 2 & 9 to 8 6 to 2 If Nos. 1 and 7 are tied together, leave as is; if No. 7 is grounded and No. 1 goes through a bias network, remove the ground from No. 7 and move leads from No. 1 to No. 7.
	6BW6	P	Parallel circuits only. Rewire as follows: No. 9 to No. 2 3 to 8 1 to 3 7 to 9 6 to 7
	6BY7	G	Parallel circuits only. Rewire as follows: No. 9 to No. 2 7 to 9 6 to 7 3 to 8 Ground No. 6
	6CK6	G	Rewire as follows: Reverse No. 1 and No. 3 Reverse No. 6 and No. 7 No. 8 to No. 1 Ground No. 8
	6M5	G	Rewire as follows: No. 9 to No. 2 Remove wires from No. 3. No. 1 & 7 to No. 3 8 to 1 6 to 7 Connect wires removed from No. 3 to No. 1
6CS6	6BE6	G	No changes.
6CU6	6BQ6GT	E	No changes.
6J5	12AT7	G	This substitution utilizes both halves of the dual triode in parallel as the replacement tube. Same as 6J5 to 12AU7. In addition, connect Nos. 1 to 6, 2 to 7, and 3 to 8.
	12AU7	E	This substitution utilizes one half of the dual triode as the replacement tube. Change socket to noval and rewire as follows: Remove and tape up any wires connected to Nos. 1, 4 and 6. No. 2 to No. 4 & 5 3 to 1 5 to 2 7 to 9 8 to 3
	12AV7	G	Same as 6J5 to 12AU7. Parallel circuits only.
	12AX7	P	Same as 6J5 to 12AT7.
	12AZ7	G	Same as 6J5 to 12AU7. Parallel circuits only.
	12BH7	G	Same as 6J5 to 12AU7. Parallel circuits only.
6M5	6CL6	G	Reverse 6CL6 to 6M5 procedure.

SUPPLEMENT—RECEIVING TUBE SUBSTITUTION GUIDE

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6Q4	6AM4	G	Parallel circuits only. Rewire as follows: Remove and tape up any connections to No. 6. No. 8 to No. 6 5 to 8 9 to 5 7 to 9 4 to 7 2 to 4 3 to 2 Do not use No. 3 for tie point.
	6R4	G	Parallel circuits only. Rewire as follows: All connections to Nos. 1, 2, 7 and 8 must be moved to No. 1 No. 9 to No. 8
6R4	6Q4	G	Parallel circuits only. Rewire as follows: Remove and tape up any connections to Nos. 2, 7 and 9 No. 8 to No. 9
6S8GT	6R8	G	Parallel circuits only. Change socket to noval and rewire as follows: No. 1 on octal to No. 1 on noval 2 to 7 3 to 2 4 to 6 5 to 3 6 to 9 7 to 4 8 to 5 top cap to 8
	6V8	E	Parallel circuits only. Change socket to noval and rewire as follows: No. 1 on octal to No. 2 on noval 2 to 3 3 to 7 4 to 9 5 to 8 6 to 1 7 to 4 8 to 5 top cap to 6
6SN7	6BL7	E	Parallel circuits only. No changes.
	6BX7	E	
6T4	6AN4	G	No changes.
6T8	6AK8	G	No changes.
6U3	6V3	E	Parallel circuits only. Rewire as follows: No. 3 to top cap
6U8	6X8	G	Rewire as follows (only if Nos. 7 and 8 are tied together): No. 1 to No. 3 2 to 7 3 to 8 6 to 9 7 & 8 to 6 9 to 2 Connect Nos. 1 and 6 together

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6V3	6U3	G	Parallel circuits only. Rewire as follows: (Be careful not to exceed the tube rating) top cap to No. 3
6V5GT	6V6GT	E	Rewire as follows: Remove and tape up any wires connected to No. 2. Connect Nos. 8 and 2 together.
6W6	6G6 6L6 5881	P	Parallel circuits only. No changes.
6X8	6U8	G	Rewire as follows: Connect Nos. 7 and 8 together. Nos. 1 & 6 to No. 8 2 to 9 3 to 1 7 to 2 8 to 3 9 to 6
12A4	12AU7	G	Rewire as follows: Remove and tape up any wires connected to Nos. 6 and 8. No. 1 to No. 3 & 8 3 to 9 9 to 1 & 6 Connect Nos. 2 and 7 together.
	12B4	G	No changes.
	12BH7	G	Same as 12A4 to 12AU7.
12AH8	6AJ8	G	This will work if the 12AH8 was operating on 6 volts. Rewire as follows: Remove jumper between Nos. 4 and 5. No. 9 to Nos. 4 or 5 (whichever has no connection) Connect Nos. 7 and 9 together.
12AK7	12AX7	E	No changes.
12AT6	6AQ6	E	Series circuits only. No changes.
12B4	12A4	G	No changes. For other substitutes see 12A4.
12BY7	6BY7	E	This can be used only where the 12BY7 is operating on 6.3 volts. Parallel circuits only. Rewire as follows: Remove wires from No. 4 to 5 then No. 6 to No. 4. Ground No. 6 (internal shield) If No. 3 is grounded, remove the connections from this point. If No. 9 is free, ground it or connect to No. 1.
12BZ7	12AX7	E	Parallel circuits only. No changes.
12S8	19T8	E	Same as 6S8 to 6T8.
	19V8	E	Same as 6S8 to 6V8.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
12SK7	12SS7	E	No changes, but in series circuits shunt 150 ohm 1 watt resistor across heater terminals, Nos. 2 and 7.
12SQ7	26BK6	G	Series circuits only. Same as 12SQ7 to 12BK6. Add 300 ohm 2 watt resistor across Nos. 3 and 4.
12SS7	12SK7	E	Make necessary circuit changes to provide additional heater current. See page 12, Section 1.
12V6	12A5	G	Change socket to small 7 pin and rewire as follows: No. 2 on octal to No. 1 on 7 pin 3 to 2 4 to 3 5 to 4 7 to 7 8 to 5 ORIG. SUB.
12X4	6X4	E	No changes, but add a 20 ohm 5 watt resistor in series with the heater.
	6X5	E	Same as 6X4 to 6X5, except to add a 20 ohm 5 watt resistor in series with the heater.
14X7	19T8	G	Series circuits only. Change socket to noval and rewire as follows: No. 1 on loctal to No. 4 on noval 2 to 9 3 to 8 4 to 7 5 to 1 or/& 6 6 to 2 7 to 3 8 to 5 ORIG. SUB.
	19V8	E	Series circuits only. Change socket to noval and rewire as follows: No. 1 on loctal to No. 4 on noval 2 to 1 3 to 6 4 to 3 5 to 9 or /& 2 6 to 7 7 to 8 8 to 5 ORIG. SUB.
19AQ5	16A5	G	Change socket to noval and rewire as follows: No. 1 & 7 to No. 2 2 to 3 3 to 4 4 to 5 5 to 7 6 to 9 Nos. 6 and 8 are internal connections Do not use for tie points. ORIG. SUB.
	35B5	G	Series circuits only. Some circuit changes may be necessary to provide the extra 15 filament volts. No other changes.
19J6	6J6	E	Rewire as follows: Disconnect heater terminals, Nos. 3 and 4. Connect these wires to a 125 ohm 3 watt resistor, which may be mounted out of the way. Use a 6 volt filament transformer to light the 6J6.
19X3	19Y3	E	No changes.
19Y3	19X3	E	No changes.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
25BK5	12BY7	P	Rewire as follows: ORIG. No. 1 to No. 7 3 & 7 to 2 6 to 1 & 3 or 9 SUB. No. 6 is heater tap. Do not use as tie point. Add 40 ohm 5 watt resistor in series with the filament.
	19AQ5	G	Change socket to 7 pin and rewire as follows: ORIG. No. 1 to No. 5 3 & 7 to 1 & 7 4 to 3 5 to 4 6 to 2 8 to 6 SUB. Remove and tape up any wires connected to Nos. 2 and 9. In parallel circuits add a 40 ohm 2 watt resistor in series with one of the filament leads. In series circuits, shunt a 120 ohm 5 watt resistor across the filament leads.
	25L6GT	E	Change socket to octal and rewire as follows: ORIG. No. 1 to No. 3 3 & 7 to 5 4 to 2 5 to 7 6 to 8 8 to 4 SUB. Connections anchored to Nos. 2 and 9 may be placed on the free terminals of the octal socket.
25L6	25BK5	E	Change socket to noval and rewire as follows: ORIG. No. 2 on octal to No. 4 on noval 3 to 1 4 to 8 5 to 3 or 7 7 to 5 8 to 6 SUB.
26A6	12BA6	G	No changes, except to add a 90 ohm 2 watt resistor in series with one heater lead.
26A7	12L8GT	G	No changes, except to add a 90 ohm 2 watt resistor in series with heater.
	28D7	G	Change socket to loctal and rewire as follows: ORIG. No. 1 on octal to No. 7 on loctal 2 to 6 3 to 2 4 to 4 5 to 3 6 to 1 7 to 8 8 to 5 SUB.
26CG6	26A6	G	No changes.
	12BA6	G	Same as 26A6 to 12BA6.
26D6	12BE6	G	No changes, except to add 90 ohm 2 watt resistor in series with heater. (Parallel circuits only)

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
28D7	26A7	G	Change socket to octal and rewire as follows: No. 1 on loctal to No. 6 on octal 2 to 3 3 to 5 4 to 4 5 to 8 6 to 2 7 to 1 8 to 7
28Z5	OZ4A/1003	G	This will work if the requirements for proper operation of the gas rectifier are met. Change socket to octal and rewire as follows: Remove and tapeup any wires connected to Nos. 1, 4 and 8. No. 3 on loctal to No. 3 on octal 6 to 5 7 to 8
50AX6G	6BY5	E	Rewire as follows: Remove wires from Nos. 2 and 7 and connect them to a 330 ohm 10 watt resistor. Remove and tape up any wires on No. 1. No. 4 to No. 1 3 to 4 The 6BY5 must be lit from a 6.3 volt 2.0 ampere filament transformer.
5590	6CF6	G	Parallel circuits only. No changes.
5591	6CF6	G	Parallel circuits only. No changes.
5670	6BK7	G	Parallel circuits only. Rewire as follows: Reverse No. 5 and No. 9 2 3 1 4

SUBSTITUTING PICTURE TUBES IN TV RECEIVERS

1. Connecting the External Conductive Tube Coating to Chassis

When a picture tube that does not have an external conductive coating is substituted for one that has the external coating, it is generally necessary to install a metal finger to make contact with the coating in order to connect it to the chassis. Sometimes this finger is attached to the deflection yoke support bracket. Ordinarily a tube that does not have an external coating has a 500-$\mu\mu$f capacitor connected from the anode lead to the chassis inside the high-voltage cage. It is normally not necessary to remove this capacitor when substituting a tube that has the external conductive coating.

2. Installing a Capacitor from the Anode Lead to the Chassis

When a tube that does not have the external conductive coating is substituted for one that has the external conductive coating, it is often necessary to install a capacitor from the anode lead to the chassis. In the substitutions listed here we have repeated the same value of 500 $\mu\mu$f. Ordinarily this will be satisfactory. In some cases this capacitor will not be necessary. In others best satisfaction may be had with capacitances as high as 2,000 $\mu\mu$f. This is according to individual cases and can be determined by trial. The most convenient location for this capacitor is inside the high-voltage cage.

3. Dimensions

Before attempting any of the substitutions listed here, make sure the substitute tube will fit into the available space. In the magnetic types try to choose a substitute with a neck length similar to the original. Differences in face plate curvatures may make it necessary, in some substitutions listed, to change the mask.

4. Change in Anode Connector

Either the ball-type or cavity-type anode connector is used on picture tubes. Instructions specify when a change is necessary.

5. Replacement or Deletion of Ion Trap

It is necessary to replace the ion trap with the type required by the manufacturer of the substitute tube. Some tubes do not require an ion trap and are being substituted for others requiring either a single or dual ion trap. In these cases,

the instruction is "Remove ion trap." Other tubes requiring a single ion trap can be substituted for by installing a dual ion trap and vice versa. In these cases instructions are given. Some manufacturers of picture tubes are using a new type gun requiring a single ion trap in tubes that formerly used a gun requiring a dual ion trap. It is therefore important to check the individual manufacturer's specification on the substitute tube being used.

6. Electrostatic and Self-Focus Tubes

When using electrostatic or self-focus tubes as substitutions for magnetically focused tubes, it is necessary to remove the focus coil from the neck of the tube and replace it with a magnetic centering device. The focus coil may be left in the receiver circuit-wise, in which case it should be mounted in the cabinet in some position where it magnetic field has no effect on the picture. It may be replaced with a choke or resistor. The picture tube socket may have to be changed when it is necessary to bring out a lead from the focus electrode on the picture tube base except in the case of self-focus or automatic focus types. This lead should be connected to a d-c voltage point in the set which gives best focus. The voltage required normally lies between 50 and 350 volts. Self-focus or automatic focus tubes have a special gun structure within the neck of the tube designed to focus the tube automatically without the use of an external focus voltage.

7. Substituting Electrostatic or Automatic Focus Types with Magnetic Types

When replacing electrostatic focus types with magnetic focus types, discard the magnetic centering device and install a permanent magnet focusing device. This must be mounted on the yoke support with suitable metal brackets. It is practical to replace an electrostatic focus tube using high-focus voltage with a type using low-focus voltage or a self-focus type. When doing this, it is desirable to remove the focus voltage rectifier as a safety measure.

8. Differences in the Face Plate

Differences in the face plate of the tube have little effect on whether or not they may be substituted. Dark-faced tubes give better contrast than white-faced tubes. Some tubes are frosted to decrease reflections and others have an aluminized back for better contrast and brightness. Aluminized tubes in some cases have higher anode voltage applied and this voltage should be reduced in accordance with manufacturers' specifications when other than aluminized tubes are substituted. When substituting aluminized tubes for white- or gray-faced tubes, sufficient voltage is usually available for satisfactory operation.

TUBE	SUB.	CHANGES NECESSARY
7HP4	7QP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change anode connector to cavity type. Change ion trap to single.
7NP4	7WP4	Connect external conductive coating to chassis.
7QP4	7HP4	Change anode connector to ball type. Connect external conductive coating to chassis. Change ion trap to double.
7WP4	7NP4	No changes.
8AP4	8AP4A	No changes. Substitute has dark face.
8AP4A	8AP4	No changes. Substitute has white face.
10BP4	10BP4A	No changes. Substitute has dark face.
10BP4 10BP4A	10CP4	Change anode connector to cavity type. Remove ion trap.
	10EP4	Change anode connector to cavity type.
	10FP4A 10FP4	Remove ion trap.
10CP4	10BP4 10BP4A	Only where 1" greater length is available. Change anode connector to ball type.
	10EP4	Only where 1" greater length is available. Change anode connector from ball to cavity type. Remove ion trap.
	10FP4 10FP4A	Change anode connector to cavity type.
10EP4	10BP4 10BP4A	Change anode connector from ball to cavity type.
	10CP4	Remove ion trap.
	10FP4 10FP4A	Change anode connector from ball to cavity type. Remove ion trap.
10FP4	10FP4A	No changes.
10FP4 10FP4A	10BP4 10BP4A	Install double ion trap.
	10CP4	Change anode connector to ball type.
	10EP4	Change anode connector from cavity to ball type. Install double ion trap.
10MP4	10MP4A	No changes.
10MP4A	10MP4	No changes.

TUBE	SUB.	CHANGES NECESSARY
12JP4	12KP4 12KP4A	Connect external conductive coating to chassis. Change anode connector to cavity type.
12JP4	12LP4 12LP4A	Only where 1 1/8" greater length is available. Change anode connector to cavity type. Install double ion trap.
	12QP4 12QP4A	Install double ion trap.
	12RP4	Install single ion trap.
	12TP4	Only where 1 1/2" greater length is available. Change anode connector to cavity type. Install double ion trap.
	12VP4 12VP4A	Change anode connector to cavity type. Install double ion trap.
	12YP4	Only where 1" greater length is available. Change anode connector to cavity. Install single ion trap. Substitute is electrostatic focus. See No. 6 in picture tube article.
12KP4	12KP4A	No changes. Substitute has dark face.
12KP4 12KP4A	12JP4	Change anode connector to cavity type.
	12QP4 12QP4A 12RP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change anode connector to ball. Install single ion trap.
	12TP4	Only where 1 1/2" greater length is available. Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Install double ion trap.
	12VP4 12VP4A	Install double ion trap.
	12YP4	Only where 1 1/2" greater length is available. Install single ion trap. Substitute is electrostatic focus. See No. 6 in picture tube article.
12LP4	12LP4A	No changes. Substitute has dark face.
12LP4 12LP4A	12JP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change anode connector to ball type. Remove ion trap.
	12KP4 12KP4A	Remove ion trap.
	12QP4 12QP4A 12RP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change anode connector to ball type. Change ion trap to single.
	12VP4 12VP4A 12TP4	No changes.
	12YP4	Change ion trap to single. Substitute is electrostatic focus. See No. 6 in picture tube article.
12QP4	12QP4A	No changes. Substitute has dark face.
12QP4 12QP4A	12JP4	Remove ion trap.
	12KP4 12KP4A	Connect external conductive coating to chassis. Change anode connector to cavity type. Remove ion trap.

TUBE	SUB.	CHANGES NECESSARY
12QP4 12QP4A	12LP4 12LP4A	Only where 1 1/2" greater length is available. Connect external conductive coating to chassis. Change anode connector to cavity type. Install ion trap.
	12RP4	No changes.
	12TP4	Only where 1 1/2" greater length is available. Change anode connector to cavity type. Change ion trap to double.
	12VP4 12VP4A	Connect external conductive tube coating to chassis. Only where 1" greater length is available. Change anode connector to cavity type. Change ion trap to double.
	12YP4	Only where 1 1/2" greater length is available. Connect external tube coating to chassis. Change anode connector to cavity type. Substitute is electrostatic focus. See No. 6 in picture tube article.
12RP4	12JP4	Remove ion trap.
	12KP4 12KP4A	Connect external conductive tube coating to chassis. Change anode connector to cavity type. Remove ion trap.
	12LP4 12LP4A	Only where 1 1/2" greater length is available. Connect external conductive tube coating to chassis. Change anode connector to cavity type. Change ion trap to double.
	12QP4 12QP4A	No changes.
	12TP4	Only where 1 1/2" greater length is available. Change anode connector to cavity type. Change ion trap to double.
	12VP4 12VP4A	Only where 1 1/2" greater length is available. Connect external conductive coating to chassis. Change anode connector to cavity type. Change ion trap to double.
	12YP4	Only where 1 1/2" greater length is available. Change anode connector to cavity type. Substitute is electrostatic focus. See No. 6 in picture tube article.
12TP4	12JP4	Change anode connector to ball type. Remove ion trap.
	12KP4 12KP4A	Connect external conductive tube coating to chassis. Remove ion trap.
	12QP4 12QP4A	Change anode connector to ball type. Change ion trap to single.
	12RP4	
	12VP4 12VP4A	Connect external conductive tube coating to chassis.
	12YP4	Connect external conductive tube coating to chassis. Change ion trap to single. Substitute is electrostatic focus. See No. 6 in picture tube article.
12UP4	12UP4A	No changes. Substitute has dark face.
12UP4 12UP4A	12UP4B	Change to single ion trap.
12UP4B	12UP4 12UP4A	Change to double ion trap.
12VP4	12VP4A	No changes. Substitute has dark face.

TUBE	SUB.	CHANGES NECESSARY
14BP4	14BP4A	No changes.
14BP4 14BP4A	14EP4 14CP4	No changes.
	14DP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
	14FP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
14CP4	14BP4 14BP4A 14EP4	No changes.
	14DP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
	14FP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
14DP4	14BP4 14BP4A 14CP4 14EP4	Connect external conductive coating to chassis. Change ion trap to single.
	14FP4	Change ion trap to single.
14EP4	14BP4 14BP4A 14CP4	No changes.
	14DP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
	14FP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
14FP4	14BP4 14BP4A 14CP4 14EP4	Connect external conductive coating to chassis.
	14DP4	Change ion trap to double.
15AP4	15CP4	Only where 1" greater length is available. Change anode connector to cavity type. Install double ion trap.
	15DP4	Change ion trap to single.
	16CP4	Only where 1" greater length is available. Change anode connector to cavity type. Install double ion trap.
	16LP4 16LP4A 16ZP4	Only where 2" greater length is available. Connect external conductive coating to chassis. Install double ion trap.
15CP4	15AP4	Change ion connector to ball type. Remove ion trap.
	15DP4	Change ion connector to ball type. Change ion trap to single.
	16CP4	No changes.
	16LP4 16LP4A 16ZP4	Only where 1" greater length is available. Connect external conductive tube coating to chassis.

TUBE	SUB.	CHANGES NECESSARY
15DP4	15AP4	Install single ion trap.
	15CP4 16CP4	Only where 1" greater length is available. Change anode connector to cavity type. Change ion trap to double.
	16LP4 16LP4A 16ZP4	Only where 2" greater length is available. Connect external conductive tube coating to chassis. Change anode connector to cavity type. Change ion trap to double.
16AP4	16AP4A	No changes.
16AP4A	16AP4	No changes.
16AP4 16AP4A	16AP4B	No changes.
16CP4	15AP4	Change anode connector to ball type. Remove ion trap.
	15CP4	No changes.
	15DP4	Change anode connector to ball type. Change ion trap to single.
	16LP4 16LP4A 16ZP4	Only where 1" greater length is available. Connect external conductive tube coating to chassis.
16DP4	16DP4A	No changes.
16DP4 16DP4A	16FP4	Change anode connector to ball type. Change ion trap to single.
	16HP4 16HP4A 16JP4 16JP4A	Connect external conductive tube coating to chassis.
	16MP4 16MP4A	Connect external conductive tube coating to chassis.
16EP4	16EP4A 16EP4B	No changes.
16EP4 16EP4A 16EP4B	16AP4 16AP4A 16AP4B	Only where 2-5/8" additional length is available. Change ion trap to double.
16FP4	16HP4 16HP4A 16JP4 16JP4A	Only where 1" greater length is available. Connect external conductive tube coating to chassis. Change anode connector to cavity type. Change ion trap to double.
	16MP4 16MP4A	Only where 2" greater length is available. Connect external conductive tube coating to chassis. Change anode connector to cavity type. Change ion trap to double.
16GP4	16GP4A 16GP4B	No changes.
16HP4	16HP4A	No changes.
16HP4 16HP4A	16JP4 16JP4A	No changes.
	16MP4 16MP4A	Only where 1" greater length is available. No changes.
16JP4	16JP4A	No changes.
16JP4 16JP4A	16DP4 16DP4A	Connect 500-$\mu\mu$f, 20 kv capacitor from anode to chassis.
	16FP4 16FP4A	Change anode connector to ball type. Change ion trap to single.

TUBE	SUB.	CHANGES NECESSARY
16JP4 16JP4A	16HP4 16HP4A	No changes.
	16MP4 16MP4A	Only where 1" greater length is available. No changes.
16KP4	16KP4A	No changes.
16KP4 16KP4A	16QP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
	16RP4	No changes.
	16TP4	No changes.
	16UP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	16XP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
16LP4	16LP4A	No changes. Substitute has dark face.
16LP4 16LP4A	15AP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change anode connector to ball type. Remove ion trap.
	15CP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	15DP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change anode connector to ball type. Change ion trap to single.
	16CP4	Connect 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	16ZP4	No changes.
16MP4	16MP4A	No changes.
16MP4 16MP4A		Same as 16JP4 substitutes.
16QP4	16KP4 16KP4A	Connect external conductive tube coating to chassis. Change ion trap to single.
	16RP4	Connect external conductive tube coating to chassis. Change ion trap to single.
	16TP4	Connect external conductive tube coating to chassis. Change ion trap to single.
	16UP4	Change ion trap to single.
	16XP4	No changes.
16RP4	16KP4 16KP4A	No changes.
	16QP4	Change ion trap to double.
	16TP4	No changes.
	16UP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	16XP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.

TUBE	SUB.	CHANGES NECESSARY
16SP4	16SP4A	No changes.
16SP4A	16SP4	No changes.
16SP4 16SP4A	16VP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to ground. Change ion trap to single.
	16WP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	16YP4	Change ion trap to single.
	16WP4A	No changes.
16TP4	16KP4 16KP4A	Only where 1" greater length is available. No changes.
	16QP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
	16RP4	Only where 1" greater length is available. No changes.
	16UP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	16XP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
16UP4	16KP4 16KP4A	Connect external conductive tube coating to chassis.
	16QP4	Change ion trap to double.
	16RP4	Connect external conductive tube coating to chassis.
	16TP4	Connect external conductive tube coating to chassis.
	16XP4	Change ion trap to double.
16VP4	16SP4 16SP4A	Connect external conductive tube coating to chassis. Change ion trap to double.
	16WP4	Change ion trap to double.
	16WP4A	Connect external conductive tube coating to chassis. Change ion trap to double.
	16YP4	Connect external conductive tube coating to chassis.
16WP4	16SP4 16SP4A	Connect external conductive tube coating to chassis.
	16VP4	Change ion trap to single.
	16WP4A	Connect external conductive tube coating to chassis.
	16YP4	Connect external conductive tube coating to chassis. Change ion trap to single.
16WP4A	16SP4 16SP4A	No changes.
	16VP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to single.
	16WP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	16YP4	Change ion trap to single.

TUBE	SUB.	CHANGES NECESSARY
16XP4	16KP4 16KP4A	Connect external conductive tube coating to chassis. Change ion trap to double.
	16QP4	No changes.
	16RP4	Connect external conductive tube coating to chassis. Change ion trap to single.
	16TP4	Connect external conductive tube coating to chassis. Change ion trap to single.
	16UP4	Change ion trap to single.
	16WP4A	Change ion trap to double.
16YP4	16SP4 16SP4A	Change ion trap to double.
	16VP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	16WP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis. Change ion trap to double.
16ZP4		Same as 16LP4 substitutes.
17AP4	17BP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	17BP4A 17BP4B 17BP4C	No changes.
	17JP4	No changes.
	17KP4	Substitute type is self-focus electrostatic. See No. 6 in picture tube article.
17BP4	17AP4	Connect external conductive tube coating to chassis.
	17BP4A 17BP4B 17BP4C	Connect external conductive tube coating to chassis.
	17JP4	Connect external conductive tube coating to chassis.
	17KP4	Substitute type is self-focus electrostatic. See No. 6 in picture tube article.
17BP4A	17BP4B 17BP4C	No changes.
17BP4A 17BP4B 17BP4C	17AP4	No changes.
	17BP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	17JP4	No changes.
	17KP4	Substitute type is self-focus electrostatic. See No. 6 in picture tube article.
17CP4	17CP4A	No changes.
17CP4A	17CP4	No changes.

TUBE	SUB.	CHANGES NECESSARY
17FP4	17FP4A	No changes.
17FP4A	17FP4	No changes.
17FP4 17FP4A	17KP4	No changes. Focus voltage rectifier may be removed as a safety measure.
17HP4	17HP4A	No changes.
17HP4A	17HP4	No changes.
17HP4 17HP4A	17KP4	No changes.
	17RP4	No changes.
17JP4	17AP4	No changes.
	17BP4	Install 500-$\mu\mu$f, 20-kv capacitor from anode to chassis.
	17BP4A 17BP4B 17BP4C	No changes.
	17KP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
17KP4	17HP4 17HP4A	Original type is self-focus. Substitute is external control electrostatic focus. See No. 6 in picture tube article.
	17BP4 17BP4A	Original type is self-focus. Substitute is magnetic focus. See No. 7 in picture tube article.
17LP4	17LP4A	No changes.
17LP4 17LP4A	17SP4	No changes.
	17VP4	No changes.
17QP4	17SP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
	17UP4	No changes.
17RP4	17HP4 17HP4A	No changes.
	17KP4	No changes.
17SP4	17LP4 17LP4A	Substitute is external control electrostatic. See No. 6 in picture tube article.
17UP4	17QP4	No changes.
17UP4	17SP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
17VP4	17LP4 17LP4A	No changes.
	17SP4	No changes.

TUBE	SUB.	CHANGES NECESSARY
19AP4	19AP4A	No changes. Substitute has gray face.
	19AP4B	No changes. Substitute has gray frosted face.
	19AP4C	No changes. Substitute has gray aluminum face.
	19AP4D	No changes. Substitute has clear frosted face.
19AP4A 19AP4B 19AP4C 19AP4D		Refer to above.
19DP4	19DP4A	No changes. Substitute has gray face.
19DP4A	19DP4	No changes. Substitute has clear face.
19DP4 19DP4A	19FP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	19GP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis. Change ion trap to single.
19EP4	19JP4	No changes.
19FP4	19DP4 19DP4A	Connect external conductive tube coating to chassis.
	19GP4	Change ion trap to single.
19GP4	19DP4 19DP4A	Connect external conductive tube coating to chassis. Change ion trap to double.
	19FP4	Change ion trap to double.
19JP4	19EP4	No changes.
20CP4	20CP4A	No changes.
	20CP4C	No changes. Substitute has treated face.
	20DP4	No changes.
	20DP4A	Connect external conductive tube coating to chassis.
	20JP4	Connect external conductive tube coating to chassis. Substitute is self-focus electrostatic. See No. 6 in picture tube article.
20CP4A	20CP4	Connect external conductive tube coating to chassis.
	20CP4C	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	20DP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	20DP4A	No changes.
	20JP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
20CP4C	20CP4	No changes. Substitute has treated face.
	20CP4A	Connect external conductive tube coating to chassis
	20DP4	No changes.

TUBE	SUB.	CHANGES NECESSARY
20CP4C	20DP4A	Connect external conductive tube coating to chassis.
	20JP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
20DP4	20CP4 20CP4C	No changes.
	20DP4A	Connect external conductive tube coating to chassis.
	20CP4A	Connect external conductive tube coating to chassis.
	20JP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
20DP4A	20CP4 20CP4C	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	20DP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	20JP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
20FP4	20GP4	Connect external conductive tube coating to chassis.
	20JP4	No changes. Focus voltage rectifier may be removed as a safety measure.
20GP4	20FP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	20JP4	No changes. Focus voltage rectifier may be removed as a safety measure.
20HP4	20HP4B	No changes. Substitute has treated face.
20HP4 20HP4B	20HP4A	Connect external conductive tube coating to chassis.
	20JP4	Connect external conductive tube coating to chassis.
	20LP4	Connect external conductive tube coating to chassis.
21EP4	21EP4A 21EP4B	Connect external conductive tube coating to chassis.
	21KP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
	21KP4A	Connect external conductive tube coating to chassis. Substitute is self-focus electrostatic. See No. 6 in picture tube article.
21EP4A	21EP4B	No changes. Substitute is aluminized.
21EP4A 21EP4B	21KP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
	21EP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	21KP4A	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
21FP4	21FP4A	Connect external conductive tube coating to chassis.
	21KP4	No changes.
	21KP4A	Connect external conductive tube coating to chassis.

TUBE	SUB.	CHANGES NECESSARY
21FP4A	21FP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	21KP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	21KP4A	No changes.
21KP4	21KP4A	Connect external conductive tube coating to chassis.
21KP4A	21KP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
21WP4	20CP4 20CP4C	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	20CP4A	No changes.
	20DP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
	20DP4A	No changes.
	20JP4	Substitute is self-focus electrostatic. See No. 6 in picture tube article.
21ZP4	21ZP4A	Connect external conductive tube coating to chassis.
21ZP4A	21ZP4	Install 500-$\mu\mu$f, 25-kv capacitor from anode to chassis.
22AP4	22AP4A	No changes.
22AP4A	22AP4	No changes.
24AP4	24AP4A 24AP4B	No changes.
24AP4B	24AP4 24AP4A	No changes.
27EP4	27GP4	No changes.
	27NP4	No changes.
	27RP4	No changes.
27GP4	27EP4	No changes.
	27NP4	Connect external conductive tube coating to chassis.
	27RP4	Connect external conductive tube coating to chassis.
27NP4	27EP4	No changes.
	27GP4	No changes.
	27RP4	No changes.
27RP4	27EP4	No changes.
	27GP4	No changes.
	27NP4	No changes.

CUMULATIVE INDEX

The following index contains all the tubes listed in the RECEIVING TUBE SUBSTITUTION GUIDEBOOK, including those given in the First and Second Supplements, for which substitutions are given. Where (0) precedes the page number, the substitution information is given on the page referred to in the original RECEIVING TUBE SUBSTITUTION GUIDEBOOK; where (1) precedes the page number, the substitution information is given on the page referred to in the First Supplement; and where (2) precedes the page number, the substitution information is given on the page referred to in the Second Supplement.

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